

2 WE CLAIM:

4 1. A rotary sprinkler, which comprises:

6 (a) a drive housing that encloses an oscillating drive having at least one movable arc limit stop that can be selectively moved by a user to adjust an angular extent of an arc segment;

8 (b) a rotary nozzle assembly carried on the drive housing and coupled to the drive located within the drive housing, wherein the rotary nozzle assembly is oscillated by the drive back and forth relative to the drive housing to water the adjustable arc segment; and

10 (c) an arc indicator carried on an exterior of the drive housing and operatively coupled to the movable arc limit stop within the drive housing to visually indicate to a user both the angular extent and absolute direction of the arc segment.

12 2. The rotary sprinkler of claim 1, wherein the drive housing and the drive which the drive housing encloses, the rotary nozzle assembly, and the arc indicator are all part of a pop-up sprinkler riser carried within a sprinkler body.

14 3. The rotary sprinkler of claim 1, wherein the arc indicator comprises an indicator band having a portion which is visible to the user with the visible portion of the indicator band having a length which is representative of the angular extent of the arc segment.

16 4. The rotary sprinkler of claim 3, wherein the ends of the visible portion of the indicator band are continuously aligned with spaced side boundaries of the arc segment to absolutely indicate the direction of the arc segment relative to a fixed reference regardless of the nozzle assembly's instantaneous position relative to the drive housing.

2 5. A rotary sprinkler, which comprises:

4 (a) an oscillating drive for watering an arc  
6 segment on the ground, wherein the arc segment has an  
8 angular extent between spaced side boundaries of the arc  
10 segment which angular extent is determined by an arc of  
12 rotation provided by the oscillating drive, wherein the arc  
14 of rotation provided by the oscillating drive is determined  
by an angular distance between two arc limit stops, and  
wherein the two arc limit stops are angularly adjustable  
relative to one another to adjust the angular distance be-  
tween the two arc limits and thereby to adjust the arc of  
rotation provided by the oscillating drive to adjust the  
angular extent of the arc segment;

16 (b) a rotary nozzle assembly coupled to the  
18 drive such that the rotary nozzle assembly is oscillated by  
the drive back and forth to water the adjustable arc seg-  
ment; and

20 (c) an arc indicator having two sides with  
22 each side of the arc indicator remaining aligned with one of  
the side boundaries of the arc segment regardless of the  
24 rotary nozzle assembly's instantaneous position during os-  
cillation of the rotary nozzle assembly to absolutely indi-  
cate to the user the arc segment's direction, and wherein  
the angular distance between the sides of the arc indicator  
26 corresponds to the angular distance between the two arc  
limit stops to represent the angular extent of the arc seg-  
28 ment.

30 6. The rotary sprinkler of claim 5, wherein the two  
32 arc limit stops comprise one fixed arc limit stop and one  
movable arc limit stop, wherein the movable arc limit stop  
34 is angularly adjustable towards and away from the fixed arc  
limit stop to provide the relative angular adjustment be-  
36 tween the two arc limit stops.

2           7. The rotary sprinkler of claim 6, wherein the two  
4 sides of the arc indicator comprise a fixed side aligned  
6 with the fixed arc limit stop and a movable side aligned  
8 with the movable arc limit stop.

10           8. The rotary sprinkler of claim 7, wherein the mov-  
12 able side of the arc indicator is operatively coupled to the  
14 movable arc limit stop to move in concert with the movable  
16 arc limit stop.

18           9. The rotary sprinkler of claim 7, wherein the arc  
20 indicator comprises a continuous indicator band having  
22 visible ends, and wherein the fixed and movable sides of the  
24 arc indicator comprise the visible ends of the indicator  
26 band.

28           10. The rotary sprinkler of claim 9, wherein the in-  
30 dicator band has a contrasting color relative to adjacent  
32 portions of the sprinkler to allow the indicator band to be  
34 more easily seen.

36           11. The rotary sprinkler of claim 7, wherein the arc  
indicator comprises:

          (a) a scale having a zero mark and spaced de-  
gree markings; and

          (b) a movable pointer that can be read  
against the scale;

          and wherein the fixed and movable sides of the arc in-  
dicator comprise the zero mark of the scale and the movable  
pointer, respectively.

12. A rotary sprinkler, which comprises:

          (a) a nozzle assembly for ejecting water from  
the sprinkler;

2 (b) an oscillating drive operatively coupled  
to the sprinkler for oscillating the nozzle assembly back  
4 and forth through an arc of rotation to water an arc segment  
with the arc segment having an angular extent determined by  
6 the arc of rotation through which the nozzle assembly oscil-  
lates, wherein the oscillating drive is adjustable to vary  
the angular extent of the arc segment; and

8 (c) an arc indicator comprising an indicator  
band having a visible length which varies in accordance with  
10 the angular extent of the arc segment such that the in-  
dicator band appears longer as the angular extent of the arc  
12 segment increases and the indicator band appears shorter as  
the angular extent of the arc segment decreases whereby the  
14 visible length of the indicator band visually represents the  
angular extent of the arc segment.

16  
18 13. The rotary sprinkler of claim 12, wherein the in-  
dicator band has a contrasting color with respect to ad-  
20 jacent portions of the sprinkler to allow the indicator band  
to be more easily seen.

22 14. The rotary sprinkler of claim 12, wherein the  
sprinkler includes a housing that is non-rotatable during  
24 oscillation of the nozzle assembly, and wherein the in-  
dicator band is carried on the housing such that it does not  
26 move with the nozzle assembly during oscillation of the  
nozzle assembly but remains stationary relative to the  
28 nozzle assembly.

30 15. The rotary sprinkler of claim 14, wherein the  
visible length of the indicator band is oriented on the  
32 housing to point where the arc segment being watered by the  
nozzle assembly is located on the ground.

34  
36 16. The rotary sprinkler of claim 12, wherein the in-  
dicator band circumferentially extends around the sprinkler

over a circumferential distance encompassing a maximum value provided for the arc segment, and wherein the visible length of the indicator band is provided by an adjustment member that is movable relative to the indicator band to progressively uncover the indicator band from a first end thereof towards a second end thereof as the angular extent of the arc segment progressively increases, whereby the visible length of the indicator band is formed by the uncovered portion of the indicator band.

17. The rotary sprinkler of claim 16, wherein the adjustment member includes an interior annular channel that is accessible through a slot in the adjustment member with the channel being configured to substantially cover and hide that portion of the indicator band received inside the channel, wherein the first end of the indicator band has a fixed engagement with the sprinkler outside of the annular channel with the indicator band extending circumferentially away from the first end of the indicator band to pass through the slot and to be wound around and received inside the annular channel, and wherein the indicator band is uncovered by rotation of the adjustment member relative to the indicator band such that more and more of the indicator band is located outside of the channel to be visible while less and less of the indicator band is hidden inside the channel as the arc segment increases, and vice versa.

18. The rotary sprinkler of claim 17, wherein the oscillating drive is adjustable by angularly adjusting two arc limit stops relative to one another by angularly moving at least one of the arc limit stops towards and away from the other arc limit stop, and wherein the adjustment member carrying the interior annular channel is part of an arc adjustment member that is operatively coupled to the at least one movable stop such that the indicator band is progressively

covered and uncovered by the adjustment member as the at least one movable stop is moved towards and away from the other arc limit stop.

19. The rotary sprinkler of claim 16, further including a transparent window overlying and covering the indicator band the adjustment member.

20. The rotary sprinkler of claim 12, wherein the indicator band is carried on an exterior portion of the sprinkler.

21. The rotary sprinkler of claim 19, wherein the indicator band is carried on an exterior portion of the sprinkler that is visible to an observer during oscillation of the nozzle assembly.

22. The rotary sprinkler of claim 19, wherein the indicator band is carried around a cylindrical housing of the sprinkler.

23. The rotary sprinkler of claim 12, wherein the visible length of the indicator band at a maximum length thereof extends 360°.

24. The rotary sprinkler of claim 12, wherein the visible length of the indicator band extends circumferentially around a cylindrical housing of the sprinkler.

25. The rotary sprinkler of claim 24, wherein the cylindrical housing around which the visible length of the indicator band circumferentially extends is a housing that remains rotationally stationary during oscillation of the nozzle assembly.

26. An arc indicator for a rotary sprinkler having an oscillating drive which drive is adjustable to vary the angular extent of an arc segment being watered by the sprinkler, which comprises:

(a) an indicator band having a visible portion that has a length which is related to the angular extent of the arc segment; and

(b) an adjustment member that moves relatively to the indicator band and in concert with an increase and decrease in the angular extent of the arc segment to increase and decrease the length of the visible portion of the indicator band in concert with an increase and decrease in the angular extent of the arc segment.

27. An arc indicator for a rotary sprinkler having an oscillating drive which drive is adjustable to vary the angular extent of an arc segment being watered by the sprinkler, which comprises:

an indicator band having a visible angular length that is substantially equal to and varies with the angular extent of the arc segment as the angular extent of the arc segment is adjusted such that the visible angular length of the indicator band is 30° when the angular extent of the arc segment is 30°, is 45° when the angular extent of the arc segment is 45°, and so on.

28. A rotary sprinkler which has adjustable part circle operation, which comprises:

(a) an oscillating, reversible drive for providing oscillating rotation during part circle operation, wherein the drive includes two angularly spaced arc limit stops that provide torque to a shiftable toggle member to toggle the toggle member to reverse the drive;

(b) a rotary nozzle assembly coupled to the drive for rotation therewith; and

2 (c) a stop assembly which is rotationally ad-  
3 justable relative to the toggle member, wh rein the stop as-  
4 sembly carries one arc limit stop and the toggle member car-  
5 ries the other arc limit stop such that rotational adjust-  
6 ment of the stop assembly relative to the toggle member  
7 moves the one arc limit stop angularly towards and away from  
8 the other arc limit stop to provide for adjustable part cir-  
9 cle operation, the one arc limit stop normally being dis-  
10 engaged from the toggle member to allow for rotational move-  
11 ment of the stop assembly to provide angular adjustment of  
12 the one arc limit stop relative to the other arc limit stop  
13 but momentarily engaging the toggle member when the one arc  
14 limit stop is engaged by a trip tab to reverse the drive.

16 29. The rotary sprinkler of claim 28, wherein the one  
17 arc limit stop is momentarily engaged to the toggle member  
18 by a pivotal pawl.

20 30. The rotary sprinkler of claim 29, wherein the tog-  
21 gle member includes a serrated section, and wherein the  
22 pivotal pawl pivots to engage the serrated section to mo-  
23 mentarily engage the one arc limit stop to the toggle mem-  
24 ber.

26 31. The rotary sprinkler of claim 30, further includ-  
27 ing:

28 (a) a spring for biasing the pawl in a direc-  
29 tion in which the pawl engages the serrated section of the  
30 toggle member; and

32 (b) a cam acting on the pawl to normally pre-  
33 vent the bias exerted on the pawl by the spring from pivot-  
34 ing the pawl.

36 32. The rotary sprinkler of claim 31, wherein the cam  
37 releases the pawl when the pawl is engaged by the trip tab



to allow the bias exerted on the pawl by the spring to pivot the pawl.

33. The rotary sprinkler of claim 32, wherein the cam reengages the pawl after drive reversal to pivot the pawl in a reverse direction to disengage the pawl from the serrated section of the toggle member.

34. The rotary sprinkler of claim 29, wherein the toggle member is cylindrical with a serrated section being located on an interior diameter of the cylindrical toggle member, and wherein the stop assembly has a portion which carries the pivotal pawl with the pawl carrying portion of the stop assembly being concentrically received inside the cylindrical toggle member such that the pawl pivots radially outwardly relative to the stop assembly to engage the serrated ring.

35. The rotary sprinkler of claim 34, wherein the pawl carrying portion of the stop assembly comprises a stop plate which stop plate also carries the one arc limit stop.

36. The rotary sprinkler of claim 35, further including a torsion spring for normally biasing the pawl into an engaged position in which the pawl engages the serrated section of the toggle member, the pawl having a cam surface which cooperates with a cam on an adjacent portion of the stop assembly such that the cam normally bears against the cam surface on the pawl to pivot the pawl against the bias of the torsion spring into a disengaged position in which the pawl is disengaged from the serrated section of the toggle member.

37. The rotary sprinkler of claim 36, wherein engagement of the one arc limit stop by the trip tab moves the cam

surface on the pawl out of engagement with the cam to allow the torsion spring to pivot the pawl from the pawl's disengaged position into the pawl's engaged position.

38. The rotary sprinkler of claim 36, wherein the cam is carried on a ring overlying the stop plate with the stop plate being angularly shiftable relative to the ring by an amount sufficient to disengage the cam surface on the pawl from the cam on the ring.

39. The rotary sprinkler of claim 34, wherein the serrated section comprises a serrated ring on an interior diameter of the cylindrical toggle member.

40. A rotary sprinkler which is adjustable between part circle and full circle operation, which comprises:

(a) an oscillating, reversible drive for providing oscillating rotation during part circle operation, wherein the drive includes two angularly spaced arc limit stops that cooperate with a trip mechanism for shifting the drive to reverse the drive;

(b) a rotary nozzle assembly coupled to the drive for rotation therewith;

(c) an angularly adjustable stop assembly carrying one arc limit stop to allow the one arc limit stop to be angularly moved towards and away from the other arc limit stop to provide for adjustable part circle operation; and

(d) wherein the one arc limit stop automatically moves vertically whenever the one arc limit stop is spaced 360° from the other arc limit stop to move the one arc limit stop vertically out of engagement with the trip mechanism to thereafter provide full circle operation of the drive.

10014916-102201

2 41. The rotary sprinkler of claim 40, further includ-  
4 ing a spring for vertically biasing the one arc limit in a  
6 first vertical direction to bias th one arc limit stop into  
8 a position in which it is vertically out of engagement with  
10 the trip mechanism, and wherein a tab is normally provided  
on an adjacent portion of the sprinkler for pushing the one  
arc limit stop in a second direction opposite to the first  
direction into a position where the one arc limit stop will  
normally engage the trip mechanism to provide part circle  
operation.

12 42. The rotary sprinkler of claim 41, wherein the one  
14 arc limit stop is carried on a stop plate, wherein the  
16 spring biases the stop plate in the first direction, and  
wherein the tab pushes on the stop plate in the second  
direction.

18 43. The rotary sprinkler of claim 42, wherein the tab  
20 pushes on the stop plate by pushing on a full circle ring  
interposed between the tab and the stop plate.

22 44. The rotary sprinkler of claim 43, wherein the full  
24 circle ring includes a cut-out or notch, and wherein the tab  
26 on the adjacent portion of the sprinkler enters into the  
cut-out or notch whenever the one arc limit stop is spaced  
360° from the other arc limit stop to allow the spring to  
move the stop plate and the full circle ring vertically suf-  
ficiently far to move the one arc limit stop on the stop  
plate vertically out of engagement with the trip mechanism.

30 45. The rotary sprinkler of claim 44, wherein the tab  
32 has a slanted cam surface such that when the one arc limit  
34 stop is adjusted to be less than 360° from the other arc  
limit the slanted cam surface will force the tab out of the  
cut-outs or notch to allow the tab to ride up onto the full

36

circle ring to again push the full circle ring and the stop plate in the second direction against the bias of the spring.

46. The rotary sprinkler of claim 44, further including a plurality of spaced tabs on the adjacent portion of the spring received in a plurality of spaced cut-outs or notches on the full circle ring whenever the one arc limit stop is spaced 360° from the other arc limit stop.

47. The rotary sprinkler of claim 41, wherein the spring is a torsion spring.

48. The rotary sprinkler of claim 41, wherein each tab provided on the adjacent portion of the sprinkler enters into a cut-out or notch provided in a portion of the adjustable stop assembly to allow the portion of the stop assembly having the cut-outs or notches to move vertically in the first direction under the influence of the spring, such motion in the first direction of the portion of the stop assembly allowing the one arc limit stop to also move vertically into a position in which the one arc limit stop is vertically out of engagement with the trip mechanism.

49. A rotary sprinkler which has adjustable part circle operation, which comprises:

(a) an oscillating, reversible drive for providing oscillating rotation during part circle operation;

(b) a rotary nozzle assembly coupled to the drive for rotation therewith; and

(c) a buckling spring assembly having first and second over-center, bi-stable positions with the buckling spring assembly being in the first bi-stable position when the drive provides rotation to the nozzle assembly in a first direction and with the buckling spring assembly being

in the second bi-stable position when the drive provides rotation to the nozzle assembly in a second direction which is opposite to the first direction; and

(d), wherein the buckling spring assembly comprises:

(i) a compression spring having opposite ends;

(ii) first and second pivot members that are spaced from one another with the pivot members having pins or dowels that generally face one another, wherein the opposite ends of the compression spring are received on the facing pins or dowels such that the compression spring extends between and is connected to the first and second pivot members; and

(iii) wherein pivoting motion of the first pivot member relative to the second pivot member causes the compression spring to buckle between the ends of the spring as the buckling spring assembly moves from one bi-stable position towards another bi-stable position with such buckling motion of the compression spring then causing the second pivot member to pivot to reverse the drive.

50. The rotary sprinkler of claim 49, wherein the first and second pivot members are carried on a common base plate.

51. The rotary sprinkler of claim 51, wherein the first and second pivot members pivot on pivot pins that are carried on the base plate with the pivot pins being spaced apart from one another on the base plate and with the pivot pins being parallel to one another.

52. The rotary sprinkler of claim 51, wherein the pivot pins are perpendicular to the dowels or pins which receive the ends of the compression spring.

2           53. A rotary sprinkler which has adjustable part cir-  
cle operation, which comprises:

4           (a) an oscillating, reversible drive for  
providing oscillating rotation during part circle operation;

6           (b) a rotary nozzle assembly coupled to the  
drive for rotation therewith; and

8           (c) a buckling spring assembly having first  
and second over-center, bi-stable positions with the buck-  
ling spring assembly being in the first bi-stable position  
10 when the drive provides rotation to the nozzle assembly in a  
first direction and with the buckling spring assembly being  
12 in the second bi-stable position when the drive provides  
rotation to the nozzle assembly in a second direction which  
14 is opposite to the first direction; and

16           (d), wherein the buckling spring assembly com-  
prises:

18                   (i) a common base plate;

20                   (ii) first and second pivot members  
pivotally connected to the base plate by first and second  
pivot pins that extend outwardly from one side of the base  
22 plate with the first and second pivot pins being parallel to  
one another, wherein the first pivot member is pivotally  
24 received on the first pivot pin and the second pivot member  
is pivotally received on the second pivot pin and when the  
26 first and second pivot pins are so received they are spaced  
from one another along the base plate; and

28                   (iii) a compression spring extending  
along the base plate with the compression spring having  
30 first and second ends, wherein the first end of the compres-  
sion spring is attached to the first pivot member and the  
32 second end of the compression spring is attached to the sec-  
ond pivot member with an intermediate portion of the com-  
34 pression spring being unsupported such that the compression  
spring can buckle between its ends in the intermediate por-

tion of the compression spring as the first pivot member is pivoted relative to the second pivot member.

54. The rotary sprinkler of claim 53, wherein the first and second ends of the springs are connected to the first and second pivot members by virtue of each spring end being received around a dowel or pin carried on one of the pivot members.

55. A method of manufacturing rotary gear drives for a rotary sprinkler which drives provide both continuous and intermittent rotation, which comprises:

(a) manufacturing a continuous version of the sprinkler drive which comprises providing:

(i) a turbine at a lower end of the drive;

(ii) a gear train including a plurality of speed reducing gear stages stacked above the turbine with the gear stages being located in a gear case, the turbine being operatively coupled to the gear train to rotate the gear train including its speed reducing gear stages when the turbine is rotated at a particular speed by water flowing past the turbine;

(iii) an output gear located outside of the gear case and operatively connected to the gear train such that the output gear has a slower rotational speed than that of the turbine; and

(iv) wherein the gear train comprises a plurality of normal gears with regularly shaped teeth to provide continuous rotation of the output gear; and

(b) manufacturing an intermittent version of the sprinkler drive which comprises manufacturing the continuous version of the sprinkler drive except that multi-lated gears are used in place of some of the normal gears in the gear train of the continuous version of the sprinkler drive.

2           56. A friction clutch for preventing damage to a  
4 rotary drive of a rotary sprinkler during periods of forced  
rotation of a nozzle assembly of the sprinkler, which com-  
prises:

6           (a) a driving gear on the rotary drive which  
driving gear is provided with a cylindrical hub having a  
8 plurality of vertically extending teeth;

10           (b) a driven member fixed to the nozzle as-  
sembly, the driven member also having a cylindrical hub with  
a plurality of vertically extending teeth;

12           (c) wherein the cylindrical hubs on the driv-  
ing gear and the driven member are concentrically positioned  
14 relative to one another with one hub concentrically received  
inside the other hub such that an annular channel is formed  
16 between the hubs, and wherein the vertically extending teeth  
on the two hubs are located on radially inner and outer  
18 sides of the channel, respectively, with the teeth of one  
hub on one side of the channel being spaced from the teeth  
20 of the other hub on the other side of the channel so that  
the teeth of one hub on one side of the channel do not  
22 directly engage the teeth of the other hub on the other side  
of the channel; and

24           (d) a friction material arranged in the chan-  
nel between the two hubs to transfer torque from the driving  
26 gear to the driven member to rotate the nozzle assembly, the  
friction material normally transferring torque between the  
28 driving gear and the driven member but allowing the driven  
member to slip relative to the driving gear to prevent  
30 damage to the rotary drive when torque above a certain level  
is imposed on the driven member by forced nozzle rotation.

32           57. The rotary sprinkler of claim 56, wherein the  
34 friction material is an annular ring received in the channel  
between the hubs.



2 58. The rotary sprinkler of claim 57, wherein the an-  
nular ring is made of an elastomeric material.

4  
6 59. The rotary sprinkler of claim 58, wherein the ring  
is selected in conjunction with the spacing between the  
8 teeth to provide transfer of all torque below a first force  
level but to allow slipping at torque above a second force  
level.

10  
12 60. The rotary sprinkler of claim 59, wherein the ring  
is pre-lubricated in a high viscosity lubricating oil such  
14 that the pre-lubricated ring in conjunction with the spacing  
between teeth provides transfer of all torque below the  
16 first force level but allows slipping at torque above the  
second force level.

18 61. The rotary sprinkler of claim 59, wherein the  
first force level is approximately 4 inch pounds of force  
20 and the second force level is approximately 6 inch pounds of  
force.

22  
24 62. The rotary sprinkler of claim 59, wherein the  
lubricating oil has approximately the following viscosity:

	CST	SUS
28 100° F	54-58	234-258
30 210° F	10-11.5	49.7-54.9.

32 63. The rotary sprinkler of claim 56, wherein the  
vertically extending teeth on the two hubs are asymmetrical-  
ly arranged relative to one another.

34  
36 64. The rotary sprinkler of claim 63, wherein the  
teeth on one hub are spaced around the one hub at regular

circumferential intervals while the teeth on the other hub are spaced around the other hub at non-constant circumferential intervals.

65. A friction clutch for preventing damage to a rotary drive of a rotary sprinkler during periods of forced rotation of a nozzle assembly of the sprinkler, which comprises:

(a) driving and drive members having annular arrays of clutch teeth that are concentrically arranged relative to one another with one annular array of clutch teeth being concentrically received inside the other annular array of clutch teeth;

(b) an elastomeric O-ring located between the annular arrays of clutch teeth to transfer torque between the annular arrays of clutch teeth to thereby cause the driving member to drive the driven member;

(c) and wherein the clutch teeth in one annular array of teeth are spaced at non-constant circumferential intervals.

66. The rotary sprinkler of claim 65, wherein the clutch teeth in the other annular array of teeth are spaced at constant circumferential intervals.

67. The rotary sprinkler of claim 66, wherein the non-constant circumferential intervals are irregular.

68. A friction clutch for preventing damage to a rotary drive of a rotary sprinkler during periods of forced rotation of a nozzle assembly of the sprinkler, which comprises:

(a) driving and drive members having annular arrays of clutch teeth that are concentrically arranged relative to one another with one annular array of clutch teeth

being concentrically received inside the other annular array of clutch teeth;

(b) an elastomeric O-ring located between the annular arrays of clutch teeth to transfer torque between the annular arrays of clutch teeth to thereby cause the driving member to drive the driven member;

(c) and wherein the clutch teeth in the annular arrays of teeth are asymmetrical relative to one another.

69. A friction clutch for preventing damage to a rotary drive of a rotary sprinkler during periods of forced rotation of a nozzle assembly of the sprinkler, which comprises:

(a) driving and drive members having annular arrays of clutch teeth that are concentrically arranged relative to one another with one annular array of clutch teeth being concentrically received inside the other annular array of clutch teeth;

(b) an elastomeric O-ring located between the annular arrays of clutch teeth to transfer torque between the annular arrays of clutch teeth to thereby cause the driving member to drive the driven member; and

(c) wherein the O-ring is pre-lubricated in a high viscosity lubricating oil.

70. A nozzle assembly for a rotary sprinkler in which the nozzle assembly ejects a stream of water to one side of the nozzle assembly as the nozzle assembly is rotated by a rotary drive, which comprises:

(a) a nozzle housing;

(b) a nozzle cradle pivotally carried on the nozzle housing for pivoting motion relative to the nozzle cradle about a substantially horizontal pivot axis;

(c) a nozzle carried in the nozzle cradle with the nozzle having an outlet for ejecting a stream of

water, wherein the trajectory of the water stream ejected by the nozzle is raised and lowered as the nozzle cradle is pivoted upwardly and downwardly; and

(d) a radius adjustment screw carried in the nozzle cradle such that a lower end of the radius adjustment screw can move progressively out of and into the water stream exiting from the nozzle as the radius adjustment screw is screwed up and down on the nozzle cradle, the radius adjustment screw moving with the nozzle cradle as the nozzle cradle is pivoted upwardly and downwardly relative to the nozzle housing such that the radius adjustment screw once adjusted maintains a constant position relative to the nozzle even as the trajectory of the nozzle is adjusted.

71. The rotary sprinkler of claim 70, wherein the nozzle is removable from the nozzle cradle to allow nozzles with differently sized outlets to be installed in the nozzle cradle.

72. The rotary sprinkler of claim 70, wherein the nozzle cradle has a seat which receives a screw or worm on a trajectory setting shaft, rotation of the shaft acting through the screw or worm against the seat to pivot the nozzle cradle upwardly and downwardly depending upon the direction of rotation of the trajectory setting shaft.

73. The rotary sprinkler of claim 72, wherein the trajectory setting shaft extends to an exterior of the nozzle housing so that the trajectory setting shaft can be rotated from exteriorly of the nozzle housing.

74. The rotary sprinkler of claim 72, wherein the nozzle housing includes a top with the trajectory setting shaft being accessible from or through the top such that the trajectory setting shaft can be rotated from above the top of the nozzle housing.

2 75. The rotary sprinkler of claim 70, wherein the  
4 nozzle cradle carries curved tabs with one curved tab ex-  
6 tending outwardly from each side of the nozzle cradle, and  
8 wherein the curved tabs on the nozzle cradle are captured  
10 within curved slots provided in the nozzle housing to pivo-  
12 tally journal the nozzle cradle within the nozzle housing,  
14 the tabs sliding up and down in the slots as the nozzle  
16 cradle pivots.

18 76. The rotary sprinkler of claim 70, wherein the  
20 radius adjustment screw has an upper head which the user can  
22 turn to screw the radius adjustment screw upwardly and  
24 downwardly relative to the nozzle cradle, and wherein the  
26 upper head of the radius adjustment screw is received in a  
28 flexible portion of a top cover of the nozzle housing to al-  
30 low the upper head of the radius adjustment screw to tilt  
32 back or forth relative to the top cover of the nozzle hous-  
34 ing.

36 77. The rotary sprinkler of claim 76, wherein the top  
cover is a rubber cover that covers a top wall of the nozzle  
housing.

78. The rotary sprinkler of claim 77, wherein the  
flexible portion of the top cover comprises a section of the  
top cover which is separated from a remaining portion of the  
top cover by a channel and is attached to the remaining por-  
tion of the top cover only by a thin membrane which bridges  
the channel such that the section of the top cover can tilt  
or flex relative to the remainder of the top cover without  
distorting or flexing the remaining portion of the top  
cover.

79. The rotary sprinkler of claim 78, wherein the sec-  
tion of the top cover includes an opening extending there-

through which opening receives a shank of the radius adjustment screw with the shank passing through the opening, and wherein the upper head of the adjustment screw is enlarged relative to the shank of the radius adjustment screw such that the enlarged head of the radius adjustment screw rests on top of the flexible portion of the top cover.

80. A nozzle assembly for a rotary sprinkler in which the nozzle assembly ejects a stream of water to one side of the nozzle assembly as the nozzle assembly is rotated by a rotary drive, which comprises:

(a) a nozzle housing having a top cover;  
(b) a nozzle carried in the nozzle housing for ejecting stream of water therefrom, the nozzle being pivotal relative to the nozzle housing to raise and lower the trajectory of the water stream;

(c) a radius adjustment screw that pivots in concert with the nozzle to maintain a fixed relationship to the nozzle after the radius adjustment screw has been adjusted, the radius adjustment screw having a shank and an enlarged head which may be engaged by a tool for adjusting the radius adjustment screw; and

(d) wherein the enlarged head of the radius adjustment screw is received on top of a flexible portion of the top cover of the nozzle housing to be accessible from above the nozzle housing with the shank of the radius adjustment screw passing down through an opening in the top cover, wherein the flexible portion of the top cover can flex or tilt relative to a remaining portion of the top cover to accommodate the tilting of the shank of the radius adjustment screw that occurs when the trajectory of the water stream is adjusted by pivoting the nozzle.

81. The rotary sprinkler of claim 80, wherein the flexible portion of the top cover is a portion which is iso-

lated from the remaining portion of the top cover by a channel that completely surrounds the flexible portion of the top cover, the flexible portion of the top cover being connected to the remaining portion of the top cover by a thin, flexible membrane which allows the flexible portion of the top cover to flex relative to the remaining portion of the top cover by deformation of the membrane.

82. The rotary sprinkler of claim 81, wherein the flexible portion of the top cover, the remaining portion of the top cover, and the thin membrane are all integrally formed from an elastomeric material.

83. The rotary sprinkler of claim 81, wherein the thin membrane is at a bottom of the channel.

84. A rotary sprinkler, which comprises:

- (a) a drive for providing rotation;
- (b) a rotary nozzle assembly coupled to the drive for rotation therewith, the rotary nozzle assembly including a water supply tube for bringing a water flow to the nozzle assembly to allow the water flow to be ejected from the nozzle assembly; and
- (c) a flow shut off valve having a portion thereof extending into and through at least a portion of the water supply tube, the portion of the flow shut off valve received inside the water supply tube having at least one stream straightening vane located thereon.

85. The rotary sprinkler of claim 84, wherein the portion of the flow shut off valve received inside the water supply tube has a plurality of stream straightening vanes located thereon.

86. The rotary sprinkler of claim 85, wherein the stream straightening vanes are circumferentially spaced

apart relative to one another around the portion of the flow shut off valve received inside the water supply tube.

87. The rotary sprinkler of claim 84, wherein the drive provides oscillating, part circle rotation for the nozzle assembly.

88. A rotary sprinkler, which comprises:

(a) a drive for providing rotation;

(b) a rotary nozzle assembly coupled to the drive for rotation therewith, the rotary nozzle assembly including a water supply tube for bringing a water flow to the nozzle assembly to allow the water flow to be ejected from the nozzle assembly;

(c) various adjustments provided in the drive and the rotary nozzle assembly for varying operational characteristics of at least one of the drive and the rotary nozzle assembly, the various adjustments being operable from above the rotary nozzle assembly through a top cover containing various indicia relating to the adjustments; and

(d) wherein the indicia is laser etched onto the top cover.

89. The rotary sprinkler of claim 88, wherein the top cover is made of rubber.

90. The rotary sprinkler of claim 88, wherein the drive provides adjustable, oscillating, part circle rotation for the nozzle assembly, and wherein one of the adjustments comprises varying an arc or oscillation provided by the drive.

91. The rotary sprinkler of claim 88, wherein the rotary nozzle assembly has an adjustable trajectory, and wherein one of the adjustments comprises varying the trajectory of the rotary nozzle assembly.



2           92. An attachment for a rotary sprinkler having an  
4 outer sprinkler body closed by a cap at a top end of the  
sprinkler body, which comprises:

6           (a) a member that is configured to be  
releasably connected to a portion of the sprinkler; and

8           (b) an opening carried on the member, the  
opening being sized to receive an upstanding post or stake  
10 provided in the ground such that the member, and hence the  
rotary sprinkler to which the member is connected, is sup-  
ported by the post or stake.

12           93. The attachment of claim 92, wherein the member is  
14 a collar that is sized to slip over a portion of the rotary  
sprinkler.

16           94. The attachment of claim 93, in which the collar is  
18 sized to slip over the cap at the top end of the sprinkler  
body.

20           95. The attachment of claim 94, in which the collar  
22 includes a plurality of resilient latching fingers for  
latching beneath the cap when the collar is received around  
24 the cap to hold the collar to the cap.

26           96. The attachment of claim 95, in which the resilient  
latching fingers have upwardly extending portions for allow-  
28 ing the fingers to be deflected to release the fingers from  
their latching engagement beneath to the cap when it is  
30 desired to remove the collar from the rotary sprinkler.

32           97. The attachment of claim 95, in which the collar  
includes tabs separate from the latching fingers that engage  
34 against a top side of the cap when the latching fingers  
engage beneath the cap.

2           98. The attachment of claim 92, in which the opening  
4 is a circular opening extending radially outwardly from one  
side of the member.

6           99. The attachment of claim 98, wherein the member in-  
8 cludes a releasable latch that latches the member to the  
rotary sprinkler.

10          100. The attachment of claim 99, wherein the  
12 releasable latch comprises a plurality of resilient latching  
fingers.

14          101. The attachment of claim 100, wherein the  
16 resilient latching fingers engage beneath the cap of the  
rotary sprinkler.

10044916 102201